THE IRRIGATION OF TOBACCO

IN THE

SOUTHERN INTERIOR IRRIGATED VALLEYS

OF

BRITISH COLUMBIA

1925 to 1933

A. J. MANN
TOBACCO SPECIALIST
DOMINION EXPERIMENTAL STATION
SUMMERLAND, BRITISH COLUMBIA

DOMINION EXPERIMENTAL FARMS
E. S. ARCHIBALD, B.A., B.S.A., LL.D., D.Sc., Director

DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
PAMPHLET No. 165—NEW SERIES

Published by Direction of the Hon. Robt. Weir, Minister of Agriculture,
Ottawa, Canada, 1935

In the culture of tobacco, the aim should be to apply the minimum amount of water commensurate with satisfactory growth and maturity.

TABLE OF CONTENTS

93184—1½

Irrigating bright flue tobacco, 41 days after transplanting. (Summerland.)

THE IRRIGATION OF TOBACCO

Introduction

The irrigation of tobacco as presented in this report is the result of nine years' experience in the growing of commercial and experimental crops of tobacco throughout the Southern Interior Valleys, extending from Kamloops, on the main line of the Canadian Pacific Railway, southward to the International Boundary.*

Of the various cultural operations required in the growing of tobacco, that of irrigation is probably the least understood. Due to the extremely variable conditions of habitat throughout the Kelowna Valley, the irrigation of tobacco may be expected to present major cultural problems. These problems can be determined only by actual cultural experience of the particular environment under which the crop may be grown. Invariably, the environment is different in each field and on each farm.

In this report, it is hoped that the grower of tobacco may find information which will help him to more intelligently approach his particular irrigation problem, which invariably is different from that of his neighbour.

Geography

The tobacco producing areas of the irrigated valleys of the Southern Interior extend from the main line of the Canadian Pacific Railway, southward 250 miles to the International Boundary. These areas include the districts of Ashcroft, Kamloops, Vernon, Lavington, Winfield, Kelowna, Summerland, Oliver, Grand Forks, and Keremeos.

Topography

The general aspect is that of a high rolling plateau, 1,130 to 1,700 feet in altitude, with numerous valleys which contain areas of arable bench and bottom land.

The benches vary from a few feet to several hundred feet in height, are usually broken by deep ravines, and are invariably without any active water table. The bottom lands are mostly level.

All exposures are encountered: north, south, east, and west; level, steep and rolling; sheltered and exposed.

Climate

The regional range in climate may be briefly summarized. The altitude averages about 1,300 feet. Clear, dry, bracing atmosphere prevails with a noticeable absence of very severe storms. The day temperature is high but the mean temperature is moderated by persistently cool nights. The precipitation is light, the average being from 8 to 12 inches yearly, and fairly well distributed throughout the year, but slightly higher in June and December. The amount of summer sunshine is very high, but low in November and December. The frost-free period is generally sufficient for safe crop production.

* At the time of writing this report, the tobacco producing area in the Southern Interior was confined to Kelowna only. It is doubtful whether the production of tobacco will again extend to all the other districts mentioned.

Some Conditions of Habitat during July and August

The average daily maximum air temperature may record approximately 84° F.; occasional peak temperatures may rise to 90° F., and over 100° F. The daily evaporation of water from an open tank may amount to 0·17 to 0·22 inch. The soil at depths of 4, 6 and 8 inches may record temperatures of 104, 87 and 85° F., respectively. The humidity at 9 a.m. may register about 48 per cent, and at 4 p.m. as low as 18 to 20 per cent. On the lighter soils, typical of the beach lands, soil moisture determinations taken prior to each irrigation may record practically no water available to a crop of tobacco. These conditions of habitat are major factors influencing the irrigation requirement of tobacco.

Soil

In general, the soils are alluvial. Both surface and sub-soil are mostly sandy, silty loams. The sub-soils are frequently underlain with sand, gravel and sandy loam. Invariably, the bench soils require irrigation to sustain cultivated crops. The bottom land soil may or may not require irrigation to support crop growth, owing to the water table varying from a few inches to 60 inches below the surface of the soil. The soils are extremely variable, typical of soils in a mountainous region.

The soil acidity, organic matter content, and mechanical analyses of soils which produced the burley tobacco crop throughout the irrigated valleys of the Southern Interior during 1925 to 1933 are presented in Table I.

TABLE I.—MECHANICAL ANALYSES OF SOILS WHICH PRODUCED THE BURLEY TOBACCO CROP IN THE IRRIGATED VALLEYS OF THE SOUTHERN INTERIOR OF BRITISH COLUMBIA, 1925-1932

Soil No.	Soil acidity or hydrogenion concentration (7·0 is neutral)	Organic matter in soil (loss on ignition)	Mechanical analyses							Soil class
			Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay	
	pH*	%	%	%	%	%	%	%	%	
1.....	6·80	6·25	3·64	4·00	4·82	8·65	14·50	26·64	37·60	Clay.
2.....	7·00	4·84	0·06	0·32	1·41	20·50	44·51	9·03	24·17	Sandy loam.
3.....	6·70	4·72	0·96	2·15	4·26	14·93	32·23	28·74	16·73	Fine sandy loam.
4.....	7·50	5·21	0·45	0·81	2·36	14·10	39·54	27·86	14·88	Fine sandy loam.
5.....	7·60	4·76	0·08	0·26	2·29	18·30	51·79	13·34	13·94	Very fine sandy loam.
6.....	7·17	10·30	0·41	1·14	3·35	12·72	25·30	43·30	13·78	Loam.
7.....	7·00	7·88	8·56	7·35	5·20	13·49	28·82	25·26	11·32	Sandy loam.
8.....	7·60	5·95	0·04	0·41	2·08	14·29	56·65	17·47	9·06	Very fine sandy loam.
9.....	7·00	3·28	0·15	0·86	1·61	7·50	53·93	27·50	8·45	Very fine sandy loam.
10.....	7·10	2·43	1·60	2·48	5·27	24·39	36·39	22·95	6·92	Fine sandy loam.
11.....	7·20	3·92	8·40	13·95	11·94	15·47	26·74	17·11	6·39	Sandy loam.
12.....	6·60	.....	6·29	11·91	10·76	17·40	27·72	19·25	5·97	Sandy loam.
13.....	6·93	4·69	0·34	1·02	3·68	25·93	45·91	18·13	4·99	Very fine sand.
14.....	7·35	5·95	1·58	1·48	2·71	8·27	35·32	45·99	4·65	Silty loam.
15.....	6·80	3·91	5·49	18·05	20·69	30·62	13·73	7·45	3·97	Medium fine sand.
16.....	7·63	3·76	5·92	3·95	4·98	12·68	32·60	36·35	3·52	Silty loam.
17.....	7·50	2·10	3·73	3·42	7·51	26·78	34·87	21·44	2·25	Very fine sand.
18.....	7·15	2·90	0·65	1·75	7·50	28·12	36·38	23·38	2·22	Very fine sand.
19.....	6·65	5·89	6·59	3·62	4·33	10·30	38·48	34·75	1·93	Very fine sand.
20.....	6·45	4·85	0·65	3·60	9·58	13·67	28·98	41·64	1·85	Silty loam.
21.....	7·20	1·90	11·55	4·55	5·68	13·52	31·09	31·86	1·75	Very fine silty sand.
22.....	6·00	4·82	4·51	2·60	3·92	9·37	40·62	37·30	1·48	Very fine silty sand.
23.....	6·85	4·56	1·12	2·15	8·32	34·20	35·74	17·00	1·47	Very fine sand.
Average	7·03	4·77	3·16	3·99	5·84	17·18	35·30	25·81	8·66	

Depth of soil, 0 to 12 inches.
These analyses include soils from Kamloops, Vernon, Lavington, Winfield, Kelowna (including Glenmore, Belgo, Benvoulin and Okanagan Mission), Summerland, Oliver, Grand Forks, and Keremeos.

Table I shows that these soils have a reaction of about 7 pH, which is approximately neutral, neither acid nor alkaline. The organic matter amounts

* pH is a yardstick for measuring the degree of acidity: a pH between 6 and 7 is regarded as slightly acid; between pH 4 and pH 5 is very acid, above pH 7 is alkaline.

to about 5 per cent. Gravel, sand, silt and clay in the proportions of 3, 62, 26 and 9 per cent, respectively, approximately characterize the texture of these soils.

The Comparative Irrigation Requirement of Some Soils listed in Table I

Soil
No. District

1. *Kelowna*—heavy bottom land, irrigation usually not required.
4. *Winfield*—level bottom land, no irrigation required.
5. *Kelowna*—level bottom land, irrigation usually not required, depending on the character of the season.
6. *Kelowna*—level bottom land, some seasons may require a single moderate irrigation.
7. *Grand Forks*—fairly level semi-bench land, several medium irrigations are required.
8. *Kelowna*—level bottom land, usually at least one irrigation is required.
9. *Kamloops*—fairly level semi-bench land, several medium irrigations are required.
11. *Summerland*—moderately sloping bench land, several medium irrigations are required.
16. *Kelowna*—Level bottom land, irrigation usually not required.
18. *Oliver*—fairly level semi-bench land, several medium irrigations are usually required.

In comparing these soils it should be noted that the character of the subsoil and underlying soil strata, the height of the water table, and exposure may influence the irrigation requirement of tobacco to a greater extent than the character of the surface soil.

Irrigation Practice is Relative Only

Although the irrigation of tobacco is an exacting cultural operation, the irrigation practice should be considered as relative only, and not applicable to any large area.

The variable conditions of habitat, especially of soil, soil moisture and topography, indicate that in actual practice, there can be no fixed irrigation practice in the judicious irrigation of tobacco. Furthermore, no two seasons are exactly alike, the irrigation practice that succeeds in one year may fail in the next year, because the conditions of soil or of the season or of the crop have altered.

Thus, the irrigation requirement of a tobacco crop is never twice the same. Each district and each field within a district where tobacco is grown, will yearly present a different irrigation problem. Therefore, irrigation practices should be considered as relative only and applicable to very small areas, and should be governed by actual conditions existing at the time. The most dependable guide in the judicious irrigation of tobacco is experience in its culture and an understanding of the local habitat.

The Tendency is to Over-Irrigate

Irrigation methods, as practised in the culture of tobacco throughout these districts, indicate in many instances that the rate of application is in excess of what is required by the crop. The tendency is to over-irrigate, especially by growers who are inexperienced in the culture of tobacco.

The response of the tobacco plant when grown under irrigation indicates that it is safer to under-irrigate than to over-irrigate. An excess of irrigation may depress normal growth and in some instances, especially where tobacco is grown on light sandy and gravelly bench land, develop Frenching, a non-parasitic, physiological disease which rapidly ravages the crop.

Frequency of Irrigation

Bench land may require three to seven moderate irrigations per season to sustain a tobacco crop to maturity, the more frequent irrigations being required on the lighter and more exposed soils during seasons characterized by low precipitation, high temperature and strong wind.

Bottom land may require one or two irrigations and in some instances no irrigation, depending on the condition of the soil, the height of the water table, and the character of the season. Following a dry autumn, winter and spring, both bench and bottom land may require irrigation prior to transplanting. In most seasons, irrigation is not required on bottom land prior to transplanting.

Rate of Irrigation

Bench land: Moderately frequent medium irrigations of from six to twelve hours' duration is a safer practice than heavy irrigations of longer duration less frequently applied. Some bench soils, however, cannot be thoroughly irrigated under two days. Nevertheless, it is safer to shorten the irrigation period.

Bottom land: The irrigation of bottom land usually requires a large flow of water applied in from two to six hours, the rate and time of flow depending on the class and tilth of soil, the lay of the land, and the length of the run.

Bottom land of fine texture which contains a fair amount of clay, when irrigated prior to transplanting, should not be worked until sufficiently dry. Such soil when worked in too wet a condition, puddles, especially if the irrigation is done by flooding.

Irrigation Practice on Bench Land at Summerland Experimental Station

The land is ploughed in the autumn, and worked early in the spring, and again just prior to transplanting. This procedure tends to conserve the natural moisture which is better distributed throughout the soil than can be achieved by irrigation. Furthermore, conservation of the natural soil moisture usually obviates the necessity of early irrigation which tends to chill the soil.

During tillage, care is exercised to prevent undue injury to the shallow fibrous rapidly-spreading root system, characteristic of the tobacco plant. Small irrigation furrows are used, and the most careful attention is given in the selection and operation of the cultivator.

Irrigation is not substituted for cultivation. Usually three hoeings and four cultivatings constitute a season's operation.

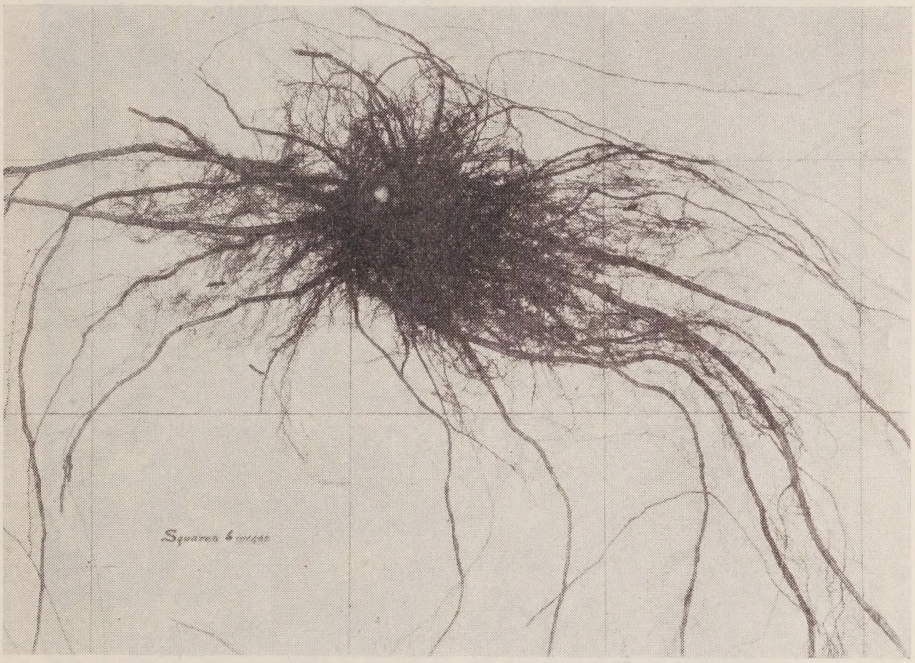
To mitigate the danger of chilling the tobacco crop, and also to facilitate the constant careful supervision of irrigation, water is applied during the daytime only.

The amount and frequency of irrigation is not determined by the condition of the crop which may be located on areas of soil unsuitable for the culture of tobacco but by the condition of the crop on the average of the more favourable areas of soil within the field.

Irrigation gates are one inch in diameter. During irrigation, these gates are opened approximately one-tenth of an inch which maintains a relative flow of one gallon per minute. This rate ensures a fairly slow flow of water, lessens soil washing, and reduces wastage of run-off water at the end of the irrigation furrow which is approximately 200 feet in length.

If the land requires irrigation prior to transplanting, a single heavy application of water from fifteen to thirty-six hours is applied, after which the land is disked and harrowed.

During the early period of growth, very light irrigations of from four to eight hours' duration are applied in furrows close to each side of the row, the aim being to quickly and lightly irrigate within immediate reach of the plant and thus lessen the danger of unduly chilling this heat-loving crop when periods of rain and low temperature may be encountered.



The fibrous extensive root system of a tobacco plant. Within a month of transplanting, the root system of a tobacco plant, at a depth of 4 inches below the surface of the soil, may attain a spread of 40 inches. Therefore, irrigation practice which involves the working of the soil should be regulated to avoid damaging the root system.

Later irrigations are applied in furrows in the centre between the plant rows.

During mid-season growth, particularly about topping time, a medium irrigation is applied of about ten hours' duration.

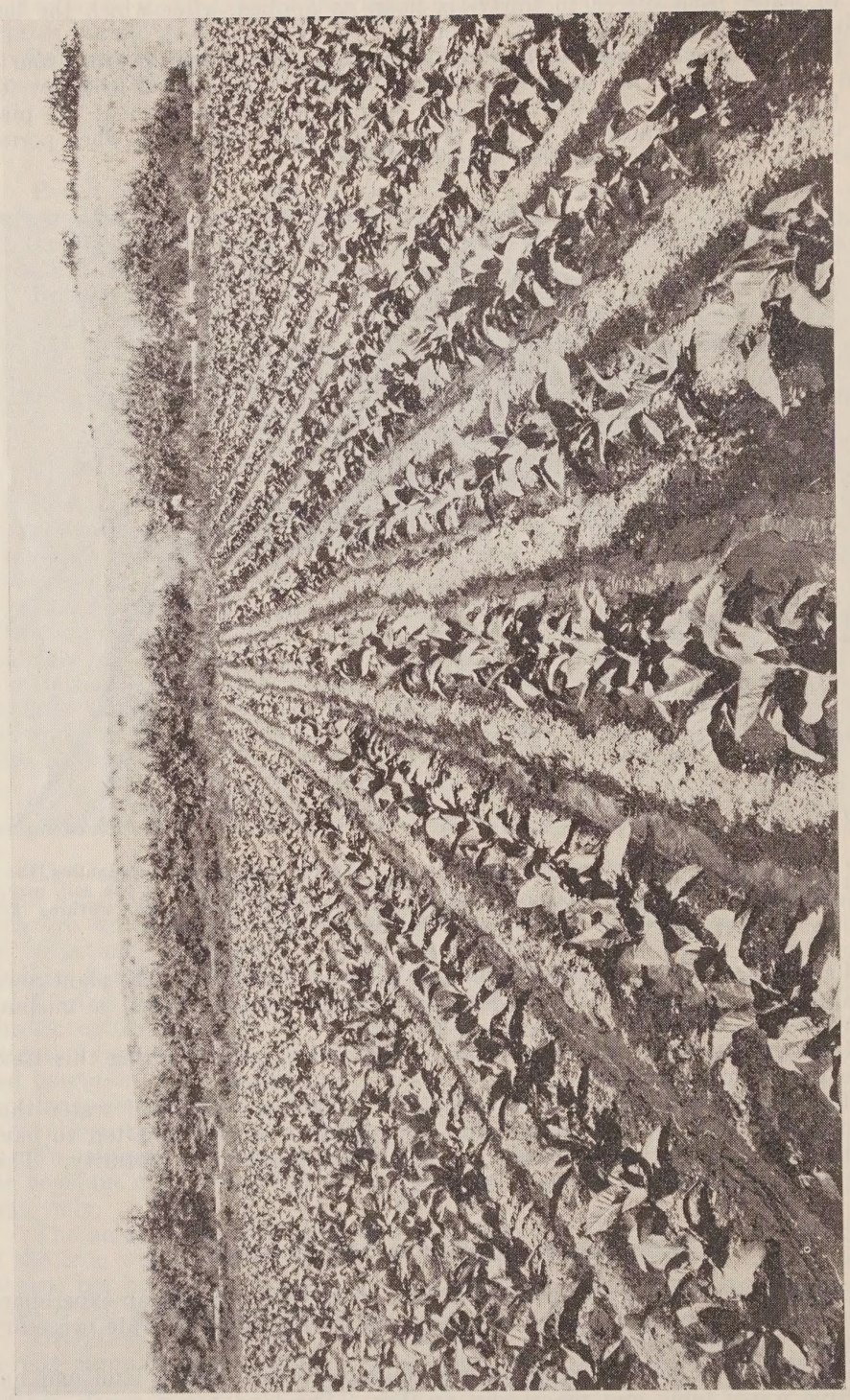
Lighter irrigations characterize the period of maturity. During this time, the length of application is reduced from six to four hours.

The irrigation objective is to apply the minimum amount of water that will promote rapid healthy growth, and at topping time or soon after, to have sufficient moisture in the soil to adequately sustain the crop to maturity. This is not easily attained.

Irrigation in Relation to Soil Moisture

Owing to the tendency of growers of tobacco to over-irrigate, an experiment was conducted applying irrigation at approximately the minimum rate necessary to sustain normal growth.

The land used for this experiment is characterized as bench land and has no active water table and practically no dew. The land has a gentle south-easterly exposure. The soil varies from a gravelly loam to a sandy loam.



Irrigating bright flue tobacco by the two-furrow system. (Summerland.)

Irrigating bright flue tobacco by the one-furrow system. (Summerland.)

During the growing months of May, June, July, and August, the precipitation was 0·29, 0·21, 0·79, and 0·66 inches respectively. The highest temperature of the season, 94° F., occurred on July 27 and August 18. The lowest humidity of the season, 18 per cent, occurred on July 27 and 29. During July and August, the evaporation from an open tank was 0·153 inch per day.

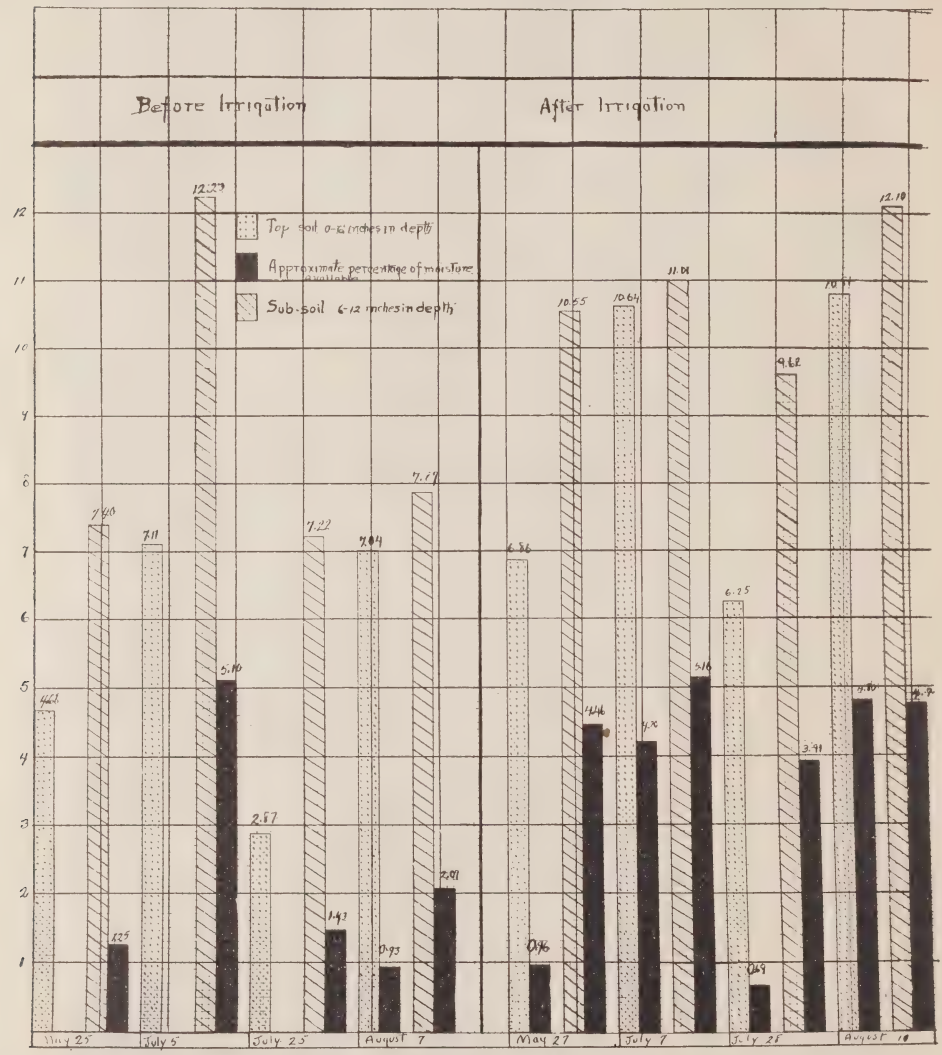


FIG. 3.—Graph showing the percentage of moisture in the surface and sub-soil, and the approximate percentage available, before and after irrigation, of Burley tobacco growing on sandy loam bench land at Summerland, 1932.

EXPERIMENTAL METHODS.—In taking samples for moisture determinations, the utmost caution was exercised to avoid exposing the soil to the drying effects of sun and air. Samples were collected as quickly as possible and immediately placed in clean, tight seamless cans and sealed with friction tape and shipped to the laboratory.

In taking samples of surface and sub-soil, 0 to 6 and 6 to 12 inches in depth, clean slices of soil were taken with a spade from freshly exposed sides of six holes at widely divergent points of a representative area. The six slices of soil

thus obtained were mixed on a canvas sheet, after which the soil was rolled forward and backward in the canvas sheet until it was thoroughly mixed. From the thoroughly mixed contents on the canvas a sample was taken, sufficient to closely pack an 8-ounce size can.

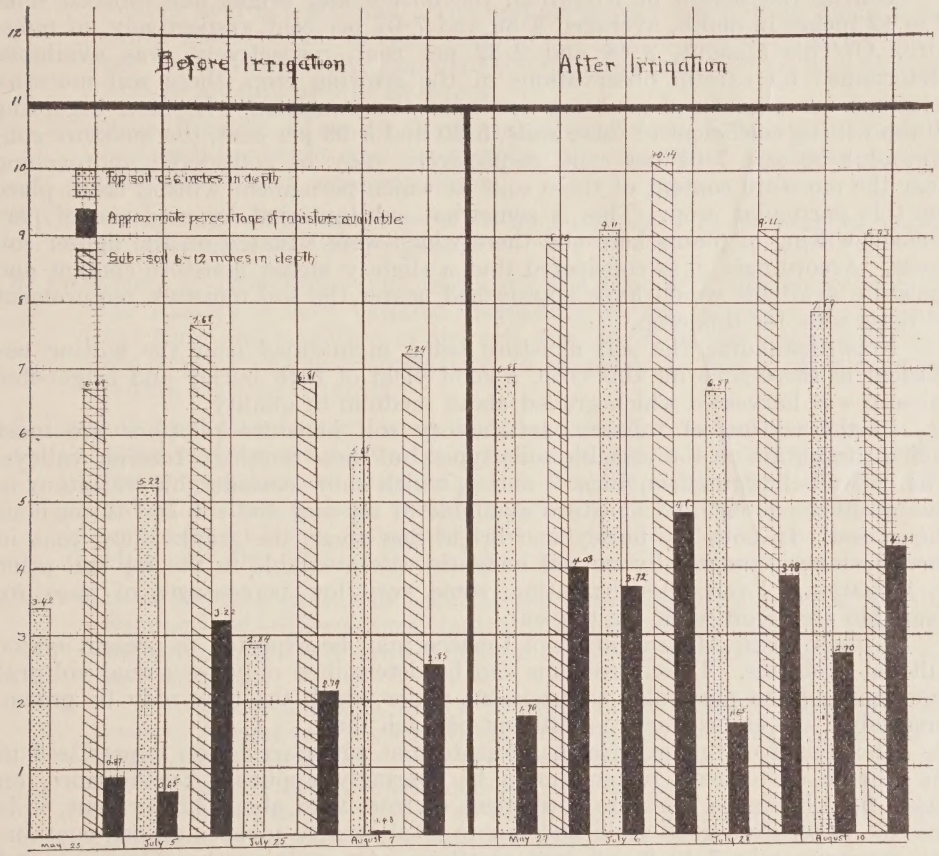


FIG. 4.—Graph showing the percentage of moisture in the surface and sub-soil, and the approximate percentage of moisture available, before and after irrigation, of bright flue tobacco growing on sandy bench land at Summerland, 1932.

The percentage of moisture in the surface and sub-soil, and the approximate percentage of moisture available, before and after each irrigation of bright-flue and burley tobacco during the growing season of 1932 are presented in Figs. 3 and 4.

Briggs, McLane and Shantz, 1907 and 1911 (1) (2) (3).—The moisture equivalent is the amount of water which a soil is capable of retaining when the soil moisture is subjected to a constant measured force sufficient in magnitude to remove the moisture from the larger capillary spaces. It represents the moisture which a soil must have in order to make it difficult to remove a very small additional amount of moisture. Thus, the moisture equivalent provides a means of determining and comparing the retentiveness of different soils for moisture when acted upon by a definite force. Moreover, the moisture equivalent indicates approximately the type of soil and the amount of organic matter present. Soils with a low moisture equivalent contain considerable amounts of sand and very little clay. The finer the soil texture, the greater is the moisture equivalent. For example, a purely clay soil might have a moisture equivalent of 45 per cent. As a rule, the more clay a soil contains, the more water it will hold.

The wilting coefficient of a soil is the moisture content of the soil at the time when the leaves of the plant growing in that soil first undergo a permanent reduction in their moisture content as the result of a deficiency in the soil moisture supply. By a permanent reduction is meant a condition from which the leaves cannot recover in an approximately saturated atmosphere without the addition of water to the soil. In the case of most plants, wilting accompanies this reduction of the water content of the leaves and is the criterion used to determine the wilting coefficient of a soil for that plant.

The water content which is available for growth is represented by the difference between the actual moisture content and the wilting coefficient.

The wilting coefficient of the soils used in the study of irrigation in relation to soil moisture was determined from the moisture equivalent data by the use of the empirical formula suggested by Briggs and Shantz (1) (3).

During the season of irrigation, the burley and bright flue tobacco soils, 0 to 12 inches in depth, averaged 8·39 and 7·07 per cent, respectively, of moisture. Of this amount, 2·48 and 2·32 per cent, respectively, was available. Determined by careful observations of the growing crop, these soil moisture relations are considered as being too near the minimum. In fact, according to the wilting coefficient of these soils, 6·30 and 5·09 per cent, the moisture content of 8·39 and 7·07 per cent, respectively, may be considered approaching near the moisture content of these soils at which permanent wilting takes place for this particular crop. This is somewhat substantiated by evidence of permanent wilting of plants here and there which were situated on the lighter soil areas. Accordingly, it is considered that a slightly higher moisture content and moisture available would have approached nearer the soil moisture requirement of these soils for this crop.

Notwithstanding the soil moisture being maintained near the wilting coefficient of these soils for this crop, a good yield of both burley and bright-flue tobacco was harvested which graded about medium in quality.

In the culture of tobacco, satisfactory soil moisture relations are most difficult to obtain on the variable soils typical of these Southern Interior valleys. This is well illustrated on Figs. 3 and 4, which show considerable variation in the moisture content and moisture available of top-soil and sub-soil throughout the season. In both the burley and bright-flue areas, the graphs show that in three instances, practically no soil moisture was available in the top-soil prior to irrigation. Even after irrigation, some very low percentages of moisture available are recorded in the top-soil.

In these areas, the irrigation of tobacco may be expected to present major cultural problems. These problems can be determined only by actual cultural experience of the particular environment under which the crop may be grown. Invariably, the environment is different on each farm.

The results of this experiment indicate that where irrigation is practised in the culture of tobacco, water should be sparingly applied. Furthermore, on bench land having a moisture equivalent of from 9 to about 12 per cent, it is possible to secure a good yield and fair to good quality tobacco on soil containing approximately 7 to 8 per cent moisture. On soils of these textures and exposures, however, slightly higher soil moisture relations may be expected to approach nearer the soil moisture requirements of this crop under these conditions of environment.

Summary

1. Geography.—The tobacco producing areas of the irrigated valleys of the Southern Interior extend from the main line of the Canadian Pacific Railway, southward 250 miles to the International Boundary.

2. Topography.—The general aspect is that of a high rolling plateau, 1,130 to 1,700 feet in altitude, with numerous valleys which contain areas of arable bench and bottom land.

3. Climate.—In general the climate is satisfactory for the production of tobacco.

4. Conditions of Habitat.—Variable changing conditions of habitat, such as air and soil temperature, evaporation, humidity and soil moisture are major factors influencing the irrigation requirements of tobacco. The character of the sub-soil and underlying soil strata, the height of the water table, and exposure may influence the irrigation requirement of tobacco to a greater extent than the character of the surface soil.

5. Soil.—Both surface and sub-soil are mostly sandy, silty loams. The sub-soils are frequently underlain with sand, gravel and sandy loam. Invariably the bench soils require irrigation, whereas the bottom land soils may or may not require irrigation to sustain growth.

   The soil reaction is about 7 pH, which is approximately neutral, neither acid nor alkaline. The organic matter amounts to about 5 per cent; gravel, sand, silt and clay, in the proportions of 3, 62, 26 and 9 per cent, respectively, approximately characterize the texture of these soils to a depth of 0 to 12 inches.

6. Irrigation Practice.—Due to the variable conditions of habitat, especially soil, soil moisture and topography, the irrigation practice must be modified to suit local conditions.

7. Over-irrigating.—The tendency is to over-irrigate. It is safer to under-irrigate than to over-irrigate.

8. Frequency of Irrigation.—The frequency and time of irrigation as required for tobacco is very variable, depending on the character of the land, the class and condition of the soil, the height of the water table, and the season. From no irrigation to as many as seven irrigations per season may be required.

9. Rate of Application.—On bench land, moderately frequent medium irrigations of from six to twelve hours' duration is a safer practice than heavy irrigations of longer duration less frequently applied. The irrigation of bottom land usually requires a large flow of water applied in from two to six hours, the rate and time of flow depending on the class and tilth of the soil, the lay of the land, and the length of the run.

10. Irrigation Practice on Bench Land at the Dominion Experimental Station, Summerland.—The natural moisture in the soil is especially beneficial for promoting early growth and is conserved by maintaining the soil in good tilth.

    To prevent undue injury to the shallow fibrous spreading root system, irrigation practice which involves the working of the soil is regulated in accordance with the depth and spread of the root system.

    Irrigation is not substituted for cultivation.

    To mitigate the danger of chilling the heat-loving tobacco plant, irrigation is applied in the daytime only.

    The amount and frequency of irrigation is determined by the condition of the crop on the average of the favourable soil areas within the field.

    On bench land, a fairly slow flow of water is applied.

    If land requires irrigation prior to transplanting, a single heavy application is applied.

    During early growth, very light irrigations are applied in small furrows close to each side of the row. Later irrigations are applied in furrows in the centre between plant rows.

    Light irrigations characterize the period of maturity.

    The irrigation objective is to apply the minimum amount of water that will promote rapid healthy growth and at topping time or soon after to have sufficient moisture in the soil to adequately sustain the crop to maturity. This is not easily attained.

11. Irrigation in Relation to Soil Moisture.—Satisfactory soil moisture relations are most difficult to obtain on the variable soils typical of the Southern Interior valleys.

    In general, to a depth of 0 to 12 inches, bench soil with a moisture equivalent of from 9 to 12 per cent should contain at least from 7 to 8 per cent of moisture to sustain a crop of tobacco.

Acknowledgments

Mr. S. Barnes, Field Husbandman, Dominion Experimental Station, Swift Current, Saskatchewan, conducted the mechanical analyses of soils and soil moisture determinations.

Mr. J. E. Britton, Assistant Superintendent, photographed Plates I and II, and Mr. C. P. Nelson, local photographer, photographed Plates III and IV and Figures 3 and 4.

Mr. R. C. Palmer, Superintendent, read the manuscript and made various helpful suggestions.

Literature Cited

1. Briggs, L. J., and McLane, J. W. The moisture equivalents of soils. U.S. Dept. Agri. Bureau of Soils, Bul. 45, 1907.

2. ——————————— and Shantz, H. L. The wilting coefficient for different plants. U.S. Dept. Agri. Bul. 230, 1911.

3. ——————————— The water requirements of plants. U.S. Dept. Agri. Buls. 284 and 285, 1913 and 1927.

A bulletin entitled "Practical Information on Irrigation for British Columbia Water Users was published in 1927 by the Provincial Department of Lands, Victoria, B.C.

Precipitation of the Dominion Experimental Station, Summerland, B.C.:—
Average for eighteen years, 1916-33..... 9·84 inches.

Average for eighteen years, 1916-33, by growing months for tobacco:—

	Inches
May	0·68
June	1·06
July	0·58
August	0·66
September	0·79
Total	3·77

Ottawa: Printed by J. O. Patenaude, Printer to the King's Most Excellent Majesty, 1935.